Cyfoeth Naturiol Cymru
Natural Resources Wales

The status and distribution of the scarab beetles *Rhysothorax rufa* and *Onthophagus nuchicornis* on Welsh dunes in 2017

Ceri Watkins & Darren Mann

NRW Evidence Report No. 263

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Contents

List of Figures

List of Tables

1. Crynodeb Gweithredol

Nid yw'r Ymlusgwr Twyni Coch *Rhysothorax rufa,* sydd mewn perygl, wedi cael ei gofnodi ond ar nifer fach o systemau twyni yng Nghymru a Lloegr, ac nid yw wedi cael ei gofnodi yn Lloegr ers dros 15 mlynedd. Yng Nghymru, gwyddys ei fod yn Nhwyni Cynffig, lle y daethpwyd o hyd i oedolyn unigol ar 20 Gorffennaf 1994, ac yng Nghwningar Merthyr Mawr, lle y cofnodwyd oedolion unigol ym mis Mehefin 1981 ac ar 21 Mai 2006. Mae oedolion yn bwyta malurion yn y tywod. Ni lwyddodd arolwg yn 2017 i ddod o hyd i'r chwilen yn y naill leoliad neu'r llall. Ystyrir bod y dulliau rheoli cyfredol yn Nhwyni Cynffig a Chwningar Merthyr Mawr yn ystyriol ynghylch gwarchod y rhywogaeth hon.

Roedd Chwilen Dom Dillwyn *Onthophagus nuchicornis*, sydd dan fygythiad, yn helaeth ledled Cymru a Lloegr yn y gorffennol. Mae wedi dirywio'n sylweddol yn Lloegr, a gwyddys ei bod yn bodoli mwyach mewn dim ond pump o'r 30 o leoliadau lle y bu yn y gorffennol, lle nad yw'n cael ei chofnodi ond yn anaml ac yn aml fel chwilen unigol. Yng Nghymru, mae'n cael ei chyfyngu i systemau twyni tywod arfordirol, ac mae cofnodion o 15 safle o Gwningar Merthyr Mawr yn y de-ddwyrain i Forfa Harlech yn y gogledd-orllewin. Gellir gweld larfâu yn nhail amrediad o famaliaid, ond mae'n debyg eu bod yn ddibynnol ar dail llysysorion mawr megis gwartheg, merlod a defaid. Bu i arolwg yn 2017 o'r safleoedd y gwyddys amdanynt, a oedd yn defnyddio chwilio â llaw a phydewau maglu ag abwyd, ddangos *Onthophagus nuchicornis* mewn saith lleoliad – Twyni Cynffig (975 oedolyn), Cwningar Merthyr Mawr (36), Morfa Harlech (1), Twyni Oxwich (4), Twyni Pen-bre (32), Twyni Pennard (4) a Thwyni Whiteford (5). Y boblogaeth yn Nhwyni Cynffig yw'r gryfaf yn y DU. Mewn mannau eraill, mae cydberthynas gref rhwng absenoldeb a niferoedd isel, a darfyddiad pori ac ansawdd a maint y tail sydd ar gael. Ystyrir bod dulliau rheoli, gan gynnwys cyfundrefnau pori, yn ystyriol o ran gwarchod y rhywogaeth hon ar dri safle (Twyni Cynffig, Cwningar Merthyr Mawr a Thwyni Whiteford), er bod lle i wella. Mae'n sicr y byddai gwella mynediad gwartheg at dwyni symudol ac ardaloedd o dywod agored y tarfwyd arnynt o fudd i *Onthophagus nuchicornis.* Gwneir argymhellion ynghylch rheoli'r holl safleoedd lle maent yn byw ar hyn o bryd.

2. Executive Summary

The Endangered Red Dune Crawler *Rhysothorax rufa* has only been recorded from a handful of dune systems in England and Wales, and has not been recorded in England for over fifteen years. In Wales, it is known from Kenfig Burrows, where a single adult was found on 20th July 1994, and from Merthyr Mawr Warren, where single adults were recorded in June 1981 and 21st May 2006. Adults feed on detritus in sand. A survey in 2017 failed to find the beetle at either location. Current management at both Kenfig Burrows and Merthyr Mawr Warren is considered sympathetic for the conservation of this species.

The Vulnerable Dillwyn's Dung Beetle *Onthophagus nuchicornis* was formerly widespread across England and Wales. It has declined dramatically in England and is now known from just five of 30 previous locations, where it is recorded infrequently and often as single individuals. In Wales, it is restricted to coastal sand dune systems and there are records from fifteen sites, from Merthyr Mawr Warren in the south-east to Morfa Harlech in the north-west. Larvae can be found in the dung of a range of mammals but are probably dependent upon that of large herbivores such as cattle, ponies and sheep. A survey in 2017 of the known sites, utilising both hand-searching and baited pitfall traps, found *Onthophagus nuchicornis* at seven localities – Kenfig Burrows (975 adults), Merthyr Mawr Warren (36), Morfa Harlech (1), Oxwich Burrows (4), Pembrey Burrows (32), Pennard Burrows (4) and Whiteford Burrows (5). The population on Kenfig Burrows is the strongest in the UK. Elsewhere, absence and low population levels are strongly correlated to cessation of grazing and the quantity and quality of available dung. Management, including grazing regimes, are considered sympathetic for the conservation of this species at three sites (Kenfig Burrows, Merthyr Mawr Warren and Whiteford Burrows), although there is room for improvement. Increased access for cattle to mobile dunes and disturbed areas of open sand would undoubtedly benefit *Onthophagus nuchicornis.* Management recommendations are made for all currently-occupied sites.

3. Introduction

3.1. *Rhysothorax rufa*

The Red Dune Crawler *Rhysothorax rufa* (Figure 1) is a widespread species across Europe being reported from Belgium, Bulgaria, Denmark, Finland, France, Great Britain, Germany, Kazakhstan, Latvia, Lithuania, The Netherlands, Poland, Romania, Russia (Central Territory, North European Territory), Sweden, Ukraine (Löbl & Löbl, 2016) and has been introduced to Canada and U.S.A. (Löbl & Löbl, 2016). However, throughout its range it is considered 'rare' (e.g. Lumaret, 1990; Stebnicka, 1977; Vorst *et al*., 2008) and is often given a conservation status in regional Red Data Books (e.g. Glowacinski, 2002; Lane & Mann, 2016; Schaffrath, 2002). In the recent review of the conservation status of UK Scarabaeoidea (Lane & Mann, 2016), *Rhysothorax rufa* was given a UK status of ENDANGERED B2ab(ii)(iv) based on the rationale that the overall Area of Occupancy is equal to or less than 8km squared, the demonstrable continuing decline and/or with 5 or fewer modern locations.

Figure 1. The Red Dune Crawler (*Rhysothorax rufa*)

Rhysothorax rufa was first recorded in the UK from Wallasey (VC58) in May 1862 by Archer (1864), who stated 'taken not infrequently on the sand hills in the Liverpool district – chiefly in May'. Thomas *et al*. (2016) published an account of the *Coleoptera of the South Lancashire Dunes*, and summarised the known recent records from Lancashire - Formby (1975, 1983, 1989), Freshfield (2000, 2001) and Ainsdale (2005). Despite numerous and regular visits to the Sefton Coast sites over the past thirty years by several coleopterists (e.g. Bowestead, Eccles, Mann, Turner, Allan & Harrison) and a recent targeted survey (Watkins & Mann, 2017 unpub. obs.), there have been no records in over fifteen years.

The first Welsh record was reported by Jackson (1907) who recorded a single specimen of *R. rufa* that he found dead on the sand hills in the neighbourhood of Barmouth, North Wales (SH61: VC48). Whilst the precise locality is unknown, it is possible that the site is Morfa Dyffryn dunes. In Jackson's day, the dunes at Barmouth were not considered high yet he states "There is a good stretch of high sand hills here". A voucher specimen for this record has yet to be located and it is possible that this specimen is a misidentification for a teneral *Aegialia arenaria*. Fowler (1890) mentions a specimen, also from Barmouth, in the collection of the late Garneys. This record is

unsubstantiated and in the later *Additional Localities, Notes etc* (Fowler & Donisthorpe, 1913), the Barmouth specimen is credited to Jackson. There is no mention of the Garneys record in the list of Merioneth Coleoptera by Skidmore & Johnson (1969). It is therefore likely that this 'other' Barmouth capture refers to the single capture of Jackson.

A second Welsh locality was discovered by David Copestake in June 1981 when a single specimen was found crawling on bare sand at Merthyr Mawr Warren NNR (SS87: VC 41) (Mann & Ramsey, 2001), with a further record from this site in 21 May 2006 by Mark Pavett (National Museum Wales, accession number NMW.Z.2009-018) again found crawling on the sand. The only other record for *Rhysothorax rufa* for Wales is of a single specimen pitfall trapped in a dune slack at Kenfig Burrows NNR (SS78: VC41) during July 1994. The Welsh records for *Rhysothorax rufa* based on datamining Museum collections and the literature are summarised in Table 1.

Due to the sporadic occurrence between years and the extremely localised distribution on the dunes, *Rhysothorax rufa* is one of the most problematic UK Scarabaeoidea to survey.

Little is known of the biology and ecology of this species and the larvae remain unknown (Stebnicka, 1977). Chaster (1902) probably gave the most extensive account of the species during its 'heyday', providing some of the only ecological data and highlighting the extremely localised occurrence and sporadic emergence period of this species. During the 1902 'outbreak', Chaster noted that *R. rufa* occurred in an area of recently-deposited sand though "it did not occur uniformly over the whole of the bare sandy surface of the bank, but affected a very limited area, perhaps six feet by six feet." In the UK, *R. rufa* appears to be associated with open dunes, though it has once been reported on vegetated dune slacks (Mann & Ramsay, 2001). On the continent, it is associated sandy banks of inland waters (Stebnicka, 1977). From the historical accounts and the more recent captures, *R. rufa* is most likely associated with mobile dunes, areas where there has been recent disturbance on fixed dunes or inundation of sand through wind-blown deposits (e.g. comments by Chaster above). The capture from fixed vegetated dunes noted by Mann & Ramsay (2001) is likely to be the result of a dispersive flight and not a resident individual. Chaster (1902) noted that the species was actively flying in the afternoons, suggesting this species is diurnal in its activity, which is corroborated on the continent by Ziani *et al*. (2015) who noted the species 'in flight in the afternoon'.

Table 1. Welsh records for *Rhysothorax rufa* from Museum collections and published literature.

Site	Grid Ref	VC	Quantity	Date	Recorder	Method
Barmouth area	SH61NW	48	1	June 1906	Jackson, P.H.	Found dead
Kenfig Burrows NNR	SS797824	41	1	20 July 1994	Ramsey, A.J.	Pitfall trap
Merthyr Mawr Warren NNR, Candelston Castle area	SS87T	41	1	June 1981	Copestake, D.R. & Parry, J.	Hand searching
Merthyr Mawr Warren NNR	SS866772	41	1	21 May 2006	Pavett, P.M.	Hand searching

3.2. *Onthophagus nuchicornis*

Dillwyn's Dung Beetle *Onthophagus nuchicornis* (Figure 2) is widespread in the Palaearctic Region, recorded from; Albania, Armenia, Austria, Belgium, Bosnia Herzegovina, Bulgaria, Belarus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Great Britain, Germany, Georgia, Greece, Hungary, Italy, Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Moldavia, Netherlands, Norway, Poland, Romania, Portugal, Russia (Central European Territory South European Territory, North European Territory), Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine and Yugoslavia. It is known from Asia - Kazakhstan, Mongolia, Russia (West Siberia), Turkmenistan and Turkey. China (Beijing Province, Xinjiang Province) – and has been introduced into the Nearctic Region (Löbl & Löbl, 2016). Across its range, it most often associated with sandy soils. In the recent review of the conservation status of UK Scarabaeoidea (Lane & Mann, 2016), this species qualified as VU under B2ab(ii)(iv)(v) as it is undergoing continued decline and is recently (post 1990) known only from 14 locations across the UK, with an Area of Occupancy of less than 2000km².

Onthophagus nuchicornis was formerly widespread across England and Wales (Figure 3), but its true historical distribution is hard to assess due to the misidentification of *O. similis* as *O. nuchicornis* and the confusion and use of the names in the early literature (e.g. Fowler, 1890). Therefore, it is imperative that the identification of this species is confirmed by examination of vouchers.

Figure 2. Dillwyn's Dung Beetle (*Onthophagus nuchicornis*)
2a. male, 2b. female

Decline is undoubtedly continuing in England and Wales and only at a few sites is this species thriving. Since 1990, *O. nuchicornis* has been recorded from seven of its fifteen known sites in Wales and can still be found in numbers at Kenfig Burrows NNR. This is in contrast to the situation in England, where it is now recorded infrequently and often as singular individuals in only 5 of around 30 previous English localities. Drivers of this decline are most likely to be scarcity of suitable dung through cessation or disruption of grazing, land use changes such as conversion of dune systems to golf courses or holiday parks and the increased use of veterinary treatments such as avermectin-based parasiticides.

Verified data from museum collections, the National Scarabaeoidea Recording Scheme and published literature are given in Table 2. There are a few records that have yet to be verified through examination of vouchers.

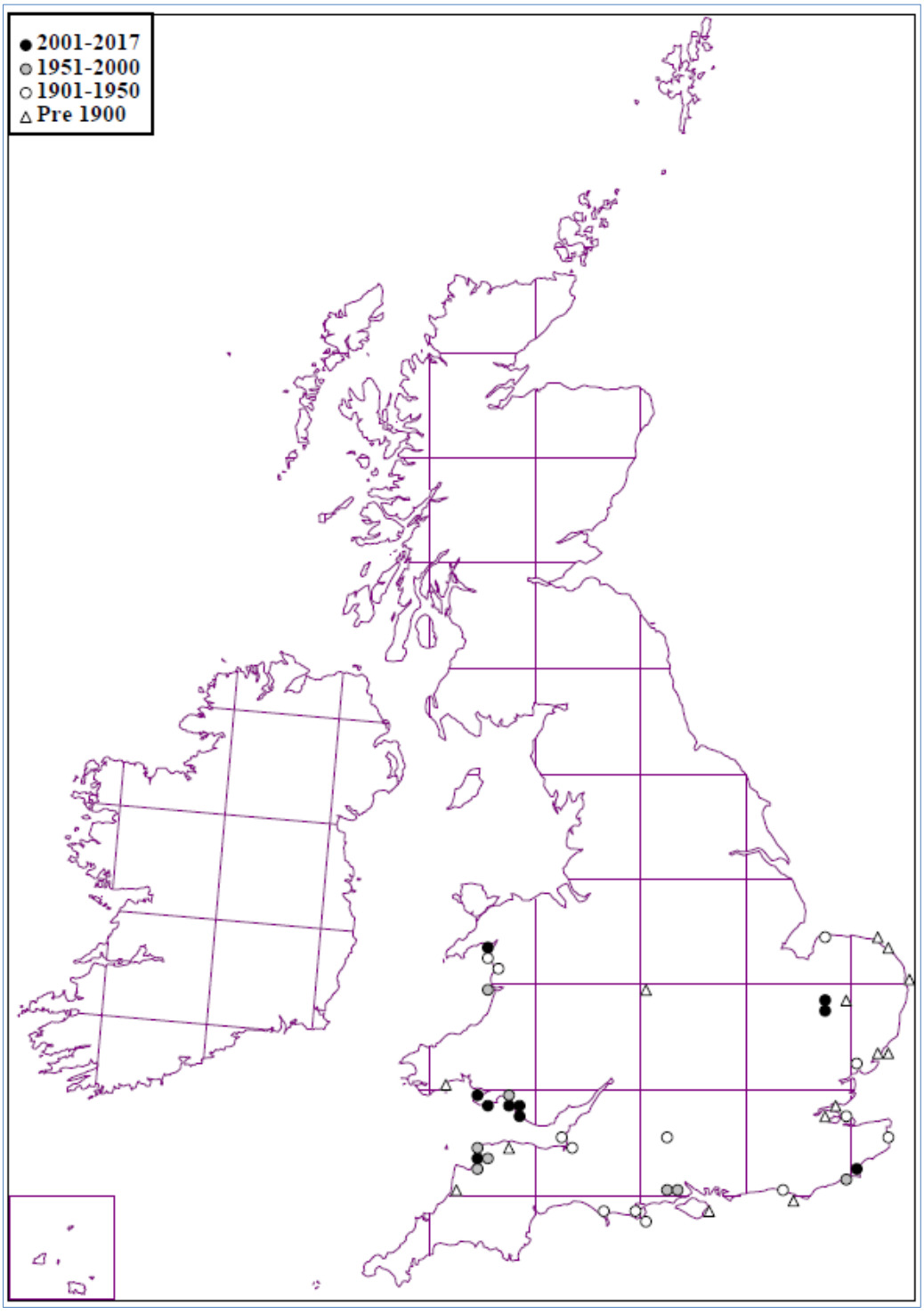

Figure 3. Distribution of *Onthophagus nuchicornis* in the UK (verified data only).

Table 2. Verified data for *Onthophagus nuchicornis* for Wales from Museum collections, Recording Scheme and published literature.

Site	Grid Ref	VC	Quantity	Date	Recorder	Method	Comment
Aberdovey sand dunes	SN59Y	48	1	04 June 1963	Gilmour, E.F.	Unknown	Voucher in Doncaster Museum – to be checked
Barmouth area	SH61NW	48	Present	1880	Blatch, W.G.	Unknown	
Barmouth area	SH61NW	48	Present	12 May 1902	Yerbury, J.W.	Unknown	
Barmouth area	SH61NW	48	1	03 Aug 1938	Tozer, D.	Unknown	Possibly dunes north of Barmouth, labelled as 'near Barmouth'
Candleston area	SS87	41	1	1899	Tomlin, J.R. Le B.	Unknown	Likely Merthyr Mawr Warren
Crymlyn Burrows SSSI	SS79B	41	Present	1828	Dillwyn, L.W.	Dung	Putative vouchers as *O. dillwynii* in Stephens Coll., NHM
Crymlyn Burrows SSSI	SS7193	41	Frequent	26 June1996	Mann, D.J.	Pitfall trap	Pitfall trap in dune slacks near burnt area
Kenfig Burrows NNR	SS7980	41	Present	12 June 1990	Kirk-Spriggs, A.H.	Dung	
Kenfig Burrows NNR	SS802820	41	1	18 July 1993	Pavett, P.M.	Unknown	
Kenfig Burrows NNR	SS802820	41	1	16 May 1995	Pavett, P.M.	Unknown	
Kenfig Burrows NNR	SS7980	41	Frequent	08 Sept 1996	Mann, D.J.	Dog Faeces	
Kenfig Burrows NNR	SS7880	41	2	23 Apr 2011	Levey, B.	Unknown	
Kenfig Burrows NNR	SS783822	41	1	26 June 2014	Sharp, N. & Facey, R.	Pitfall trap	Pitfall trap in dune excavation
Kenfig Burrows NNR	SS783822	41	12	03 July 2014	Sharp, N. & Facey, R.	Pitfall trap	Pitfall trap in dune excavation
Kenfig Burrows NNR	SS795827	41	1	04 July 2015	Mann, D.J. & Manning, P.	Cattle Dung	From single small dung pile
Kenfig Burrows NNR	SS797811	41	1	04 July 2015	Mann, D.J. & Manning, P.	Dog Faeces	
Kenfig Burrows NNR	SS797808	41	3	04 July 2015	Mann, D.J. & Manning, P.	Horse Dung	Small horse dung piles, very sporadic
Kenfig Burrows NNR	SS792826	41	78	04 July 2015	Mann, D.J. & Manning, P.	Cattle Dung	Dung scarce and mostly very old
Kenfig Burrows NNR	SS799807	41	1	23 June 2016	Mann, D.J. & Watkins, C.M.	Dog Faeces	
Kenfig Burrows NNR	SS806809	41	1	23 June 2016	Mann, D.J. & Watkins, C.M.	Horse Dung	
Kenfig Burrows NNR Kenfig Pool area	SS7981	41	Frequent	09 May 1994	Mann, D.J.	Cattle Dung	
Kenfig Burrows NNR Kenfig Pool area	SS7981	41	Frequent	29 Mar 1997	Mann, D.J.	Cattle Dung	Blow out on dunes
Kenfig Burrows NNR Kenfig Pool area	SS7981	41	1	04 July 2009	Ismay, J.W.	Unknown	
Kenfig Burrows NNR Visitor Centre car park	SS802808	41	5	04 July 2015	Mann, D.J. & Manning, P.	Dog Faeces	Dog faeces in short sward areas near main building and car park
Llangennith Burrows	SS49SW	41	1	June 1930	Harwood, P.	Unknown	
Merthyr Mawr Warren NNR	SS873769	41	1	04 July 2015	Mann, D.J. & Manning, P.	Horse Dung	Scattered pieces of horse dung along main bridleway

Site	Grid Ref	VC	Quantity	Date	Recorder	Method	Comment
Merthyr Mawr Warren NNR	SS872768	41	1	04 July 2015	Mann, D.J. & Manning, P.	Rabbit dung (Midden)	One female dug out from under sand below rabbit dung
Merthyr Mawr Warren NNR	SS866762	41	1	04 July 2015	Mann, D.J. & Manning, P.	Horse Dung	Old horse dung
Merthyr Mawr Warren NNR	SS873769	41	4	04 July 2015	Mann, D.J. & Manning, P.	Dog Faeces	Single dog faeces
Merthyr Mawr Warren NNR	SS872768	41	6	04 July 2015	Mann, D.J. & Manning, P.	Horse Dung	Scattered pieces of horse dung along main bridleway
Morfa Harlech NNR	SH563331	48	1	09 July 1996	Harrison, T.D.	Hand searching	One male found walking up bare sandy slope
Morfa Harlech NNR	SH558348	48	8	15 June 2015	Loxton, R.	Dung	
Morfa Harlech NNR	SH570316	48	1	30 Aug 2015	Spence, S.A.	Captured	Found walking on the path to the beach
Penmaen Burrows	SS5388	41	4	14 May 2005	Skidmore, P.S.	Unknown	
Pennard Burrows	SS539882	41	Present	30 May 1984	Hodge, P.J.	Unknown	
Rhossili Down	SS416890	41	1	26 July 2006	Howe, M.A.	Dung	
Tal-y-Bont dunes	SH52SE	48	1	June 1923	Wilson, W.A.	Unknown	
Tenby area	SN10F	45	1	Oct 1894	Walker, J.J.	Unknown	
Whiteford Burrows NNR	SS431941	41	Present	18 May 1985	Pavett, P.M.	Unknown	
Whiteford Burrows NNR	SS4494	41	Frequent	07 Sept 1996	Mann, D.J.	Horse Dung	
Whiteford Burrows NNR	SS451962	41	5	18 June 2001	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS4495	41	1	23 June 2001	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS440950	41	1	24 May 2003	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS4495	41	2	25 May 2003	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS443953	41	1	27 May 2003	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS454961	41	1	30 May 2003	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS443953	41	1	28 May 2004	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS443953	41	1	29 June 2004	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS432941	41	2	30 May 2005	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS452961	41	2	9 Sept 2008	Howe, M.A.	Horse Dung	
Whiteford Burrows NNR	SS446949	41	1	11 Aug 2015	Stewart, B.	Dung	
Whiteford Burrows NNR	SS446952	41	2	11 Aug 2015	Stewart, B.	Dung	
Whiteford Burrows NNR	SS448955	41	1	11 Aug 2015	Stewart, B.	Dung	

There are a number of records held in local and national record centres that are believed erroneous (Table 3 below) due to one or more of the following reasons: unlikely habitat, misidentification and/or nomenclatural issues. It is our belief that all these records should be deleted from their respective datasets or highlighted as requiring confirmation based on examination of voucher specimens.

Table 3. Erroneous records of *Onthophagus nuchicornis* from UK Record Centres.

Location	Grid Ref	Date	Recorder	Source
Cwm Dimbath, Ogmore Forest	SS950890	1985	Edwards, D.	Natural Resources Wales
Bow Street	SN6284	Apr 1959	Miles, P.	Natural Resources Wales
No locality Name	SO20	13 Aug 2001	Unknown	South East Wales BRC
No locality Name	SO20	07 Apr 2007	Unknown	South East Wales BRC
No locality Name	SO20	21 Apr 2008	Unknown	South East Wales BRC
No locality Name	SO20	19 Apr 2009	Unknown	South East Wales BRC

The biology and ecology of *Onthophagus nuchicornis* are not well known, but across most its range it is almost exclusively associated with sandy soils in open habitats (e.g. Ljungberg, 2002; Lumaret, 1990). In the UK, all known sites are from sandy soils, primarily coastal sand dune systems. Field observations in the UK during the past four years suggest that this species requires a mosaic of bare sand and low sward height, typically found on fore/yellow dunes, becoming less abundant towards grey dunes with dense vegetation or dune slacks with high soil moisture (Mann & Watkins, unpub. obs.). Where there has been a noticeable decline in population, this has been due to either cessation of grazing, disruption in dung continuity or significant reduction in the area of bare sand and short sward grassland.

Onthophagus nuchicornis is a 6-9mm paracoprid, creating a brood ball at the end of a tunnel of 5-10cm in depth directly under the dung source. In laboratory studies, it has a thermal tolerance from egg-to-adult development of between 16 – 30°C, and average development time ranged from 30 days at 30°C to 115 days at 16°C (Floate *et al*., 2015). In terms of feeding ecology, *O. nuchicornis* is a generalist coprophage. Adults have been found to feed on all types of mammal dung, although it is unclear if adults will create brood and successfully breed in dung other than that from medium to large herbivores (e.g. sheep, cattle, horse). At sites where there is a scarcity of suitable dung, *O. nuchicornis* can be found in dog faeces (e.g. Cooter, 1990), though it is unlikely be able maintain healthy populations.

3.3. Objectives of 2017 survey

The aim of the survey was to determine the current status and distribution of the scarab beetles *Rhysothorax rufa* and *Onthophagus nuchicornis* on Welsh dunes. This was to be achieved by data-mining Museum collections and the literature for records of the two species and surveying known Welsh sites during the summer of 2017. As a consequence, improvements to site management for the conservation of *Rhysothorax rufa* and *Onthophagus nuchicornis* would be suggested.

4. Methods

A desk-based study was conducted prior to the survey. All known Welsh records for *R. rufa* and *O. nuchicornis* were sourced and available information regarding the ecology and biology was reviewed. Field work was carried out from 20th May to 4th June and 17th and 18th June 2017. The localities with previous records of the target species were prioritized. Weather conditions were generally favourable throughout the survey period. An extensive range of sampling techniques were used during the survey; these are detailed below.

4.1. Visual search

A visual scan of the area was performed during daylight hours to locate dung deposits. When a dung source was located, the dung was held over a white laboratory tray and manually broken up to look for beetles inside. In each instance, the ground beneath the dung pile was examined for signs of dung beetle activity (i.e. burrows in the ground) and the sub surface layers were gently exposed to uncover tunnelling beetles. Visual searching of the open dune areas was also undertaken. This involved extensive searches of dune blow-outs and randomly sifting the sand at the base of the dunes to an approximate depth of 15cm.

4.2. Dung sieving

Dung sieving was used for horse dung, cattle dung, dog faeces and rabbit middens. Dung was roughly broken up and sieved with a 10mm mesh size sieve into a white laboratory tray. Rabbits often defecate in discrete latrine areas, usually near the burrow entrance or on top of a prominent feature such as an ant hill. In large middens, droppings of different ages and decay stages are present. The dung soil-interface is a vital component of rabbit middens and dung beetles are often found just under the surface layers. Sieving the pellet dung and underlying material is consequently of great importance.

4.3. Baited Pitfall traps

Dung-baited pitfall traps are often the best method to attract hard to find dung beetle species, particularly in areas where dung supply is scarce. A 10 mm gauge wire mesh was placed over the pit fall container to prevent the capture of small mammals and to support a fist sized ball of dung bait (Figure 4a). An upturned plastic plate secured with tent pegs was used as a rain guard (Figure 4b). Live trapping was used in areas that *O. nuchicornis* had previously been found. A 3cm layer of local sand was added to the base of the trap to act as a refuge for live beetles (Figure 5a and b). Kill traps were used in areas that *O. nuchicornis* had not previously been recorded. The preserving solution used was Propylene glycol with a small amount of diluted liquid detergent to break the surface tension. Propylene glycol is a food grade substance that is harmless to the environment and other animals.

Figure 4a. Dung baited pitfall trap.

Figure 4b. Rain guard *in situ*.

The traps were baited with horse and cattle dung. Dung was collected prior to the survey from an organic source and frozen for a period of at least 24 hours at -20 ˚C for biocontrol purposes.

Figure 5a. Live trap with beetles in sand.

Figure 5b. *Onthophagus nuchicornis* after sieving.

4.4. Night surveys

As little is known regarding the ecology of the target species, twilight and night searches for *R. rufa* were also undertaken with head torches.

4.5. 2017 survey sites

During the 2017 survey, dung beetles and their allies were recorded at a total of 42 sites including all Welsh target sites where *O. nuchicornis* and *R. rufa* had been recorded (Table 4). A map of all locations surveyed can be seen in Figure 6a. Ten live traps were used and eleven kill traps at a total of 17 sites. Figure 6b shows the location of the sites where baited pitfall sampling was carried out.

A number of other non-target sites with public access were checked and those found not to have grazing livestock have been excluded from this report. A significant proportion of accessible Welsh dune systems were surveyed through either searching and/or baited pitfall traps. The larger dune systems on the south coast of Pembrokeshire, such as Stackpole Warren, Broomhill Burrows and Brownslade & Linney Burrows were not visited during this survey as there are no known historic records and visits in previous years by the authors have not recorded *O. nuchicornis*.

Table 4. List of 2017 survey sites. Target sites are marked *

Site	Grid Ref	Site	Grid Ref
Aberdyfi [Aberdovey] dunes *	SN595692	Morfa Harlech NNR *	SH565322
Borth Sands	SN607907	Mynydd Gwerngraig	SH753136
Bridgend, Parc-y-parcau	SS891783	Nant y Cwreiddyn	SH748213
Bryn Mawr	SN728909	Nant-y-moch Reservoir	SN756862
Bwlch Mawr	SH437474	Neuadd-ddu	SN919752
Caerau area	SH468482	Newborough Warren NNR	SH429638
Candleston Farm	SS87057769	Nicholaston Burrows NT	SS521878
Cefn Bryn	SS508909	Oxwich Burrows NNR	SS503871
Crymlyn Burrows SSSI *	SS717932	Pant-y-Rhedyn	SN741796
Fairwood Common	SS573909	Pembrey Burrows *	SS409995
Ffridd Cefn-isaf	SN598970	Pembrey Country Park	SN405005
Kenfig Burrows NNR *	SS786807	Penmaen Burrows *	SS534881
Llangennith Burrows *	SS414925	Pennard Burrows *	SS53858824
Llwyngwnadl Uchaf	SH442485	Pen-y-graig	SN651925
Llwynysgaw	SH366681	Portobello House	SS873762
Madryn Farm	SH285362	Reynoldston area	SS482900
Merthyr Mawr Warren NNR *	SS863761	Rhossili Down NT *	SS415898
Moel Caerau	SH289359	Ryer's Down NT	SS450920
Moel Fferm	SN711897	Tenby, The Burrows *	SS12269897
Morfa Dinlle	SH430591	Whiteford Burrows SSSI *	SS442944
Morfa Dyffryn NNR* [Barmouth area]	SH571227	Ynyslas Dunes NNR	SN607943

Figure 6a. Map showing the location of all sites surveyed.

Figure 6b. Map showing the location of all pitfall traps during this survey.

5. Results

5.1. *Rhysothorax rufa*

Despite intensive efforts, no specimens (alive or dead) of *R. rufa* were found during this survey. In view of the limited knowledge of this species, the emergence period is very difficult to predict. Previous records for *R. rufa* suggest sporadic localised emergences in May and June and in recent years low population levels. Survey work was undertaken within the appropriate timeframe, but it is possible that we were outside the peak emergence period. However, if a large-scale emergence had taken place dead individuals should still be found. Since the surveyors found both *Aegialia arenaria, Psammodius asper* and the diminutive *Tesarius mcclayi* at a number of surveyed sites, we believe the survey technique employed was sufficient to find *R. rufa* if it were present.

5.2. *Onthophagus nuchicornis*

Onthophagus nuchicornis was found at seven out of fifteen previously known sites, representing just under 50% (Table 5). Only at Kenfig Burrows NNR was there evidence of a strong population. No new sites were discovered despite searches being undertaken at several sand dune systems in the region.

Table 5: Target sites for *Onthophagus nuchicornis* and number of scarab beetles recorded. *Figures in brackets relate to dung feeders only

Site	Grid Ref	Year last recorded	2017 *O. nuchicornis*	2017 Species Richness *	Comment
Aberdovey [Aberdyfi] dunes	SN59	1963	Not recorded	6 (4)	No grazing
Crymlyn Burrows SSSI	SS79	1996	Not recorded	4 (2)	No grazing
Kenfig Burrows NNR	SS87, SS88	2015	975	24 (18)	Strong population
Llangennith Burrows	SS49	1930	Not recorded	3 (3)	No grazing
Morfa Dyffryn NNR [Barmouth area]	SH61	1938	Not recorded	8 (6)	No grazing, old cattle dung
Morfa Dyffryn NNR [Tal-y-Bont dunes]	SH52	1923	Not recorded	See above	No grazing, old cattle dung
Merthyr Mawr Warren NNR	SS87	2015	36	25 (18)	Moderate population
Morfa Harlech NNR	SH53	2015	1	10 (7)	Low population
Oxwich Burrows NNR	SS58	2005	4	15 (15)	Low population
Pembrey Burrows LNR	SS49	2013	32	17 (12)	Moderate population
Penmaen Burrows	SS58	2005	Not recorded	8 (7)	Occasional grazing
Pennard Burrows	SS58	1984	4	9 (8)	Low population
Rhossili Down NT	SS48	2006	Not recorded	10 (10)	Low affinity habitat
Tenby dunes	SN10	1894	Not recorded	2 (2)	No grazing
Whiteford Burrows NNR	SS49	2015	5	20 (19)	Low population

5.2.1. Sites at which *Onthophagus nuchicornis* is present

Kenfig Burrows NNR

The dung beetle fauna at Kenfig Burrows NNR is likely to be one of the best in Wales, alongside Merthyr Mawr Warren NNR and Whiteford Burrows, both in terms of species richness (18) but also overall relative abundance. Kenfig was by far the most remarkable site for *O. nuchicornis*, in fact it is the largest population seen by the authors in over four years of surveys for this species across all of its UK sites. The site is continuously grazed by a small herd of mixed breed cattle that have access across the dune system from mobile to fixed dunes. There are also a number of bridle paths through the site which are used on a regular basis. *O. nuchicornis* was found throughout the grazed area and on bridleways, but was most abundant on the disturbed areas where dung was deposited on open sand and mobile dunes (Figure 7).

Figure 7. Cattle dung on bare sand exhibiting sand push-up around the edge from *Onthophagus* burrowing activity.

Merthyr Mawr Warren NNR

The dung beetle fauna at Merthyr Mawr Warren NNR is likely to be one of the best in Wales alongside Kenfig Burrows NNR and Whiteford Burrows, both in terms of species richness (18) but also overall relative abundance. However, much of this diversity is supported by the regular horse trekking on site rather than the current grazing management. A good number of horse dung piles were found on sand along riding routes (Figure 8). Encouragement of access for equine enthusiasts via the provision of suitable facilities such as an easily accessible car park and Merthyr Mawr Estate permit scheme is likely a key feature. Dune systems are useful for getting horses fit and this will attract competitive riders as well as leisure riders. Although there were cattle grazing on site during the survey period, the livestock were restricted to the fixed dune and dune scrub areas which is of limited value for *O. nuchicornis*.

Figure 8. Bridleway at Merthyr Mawr Warren NNR with fresh horse dung. Ideal for *Onthophagus nuchicornis.*

Morfa Harlech NNR

This site has, in the past, had a healthy dung beetle fauna of some 20 species. However, during the survey period the site had no grazing, although old cattle dung was noted. This lack of dung availability would account for the low species rich (7) and low relative abundance, with most species being recorded through the use of baited pit fall traps and in dog faeces. The lack of continuity of dung supply through the breeding season for *O. nuchicornis* will reduce the viable population of this species. A single specimen was captured in a trap at this site.

Oxwich Burrows NNR

The dung beetle fauna was disappointing, since there was relatively high species richness (15) the overall relative abundance was extremely low (just 78 individuals). There was adequate dung in suitable areas for *O. nuchicornis* but we were only able to find four individuals, and none was trapped on site. Horses graze the site but are primarily situated to the rear of the dune slacks in a dry grassland area that has a long sward. The dune system here is relatively fixed with few blowouts of good size but some patches of bare sand are apparent. The horse dung is reflective of the grass and tends to lack moisture content (Figure 9). This appears to make the dung less favourable to dung beetles and old dung with limited degradation was scattered across the site.

Figure 9. Dry dung at Oxwich Burrows NNR
with limited dung degradation due low beetle activity.

Pembrey Burrows

The dung beetle fauna at Pembrey Burrows had a reasonable species richness (12) and relative abundance. This site has horse trekking in addition to on-site grazing. The on-site grazing is not in an ideal area for *O. nuchicornis* since the livestock are fenced in and unable to reach the majority of the site, including the wider area of mobile dunes. However, there are areas of suitable open sand within the grazed area and it was generally in these that *O. nuchicornis* were found (Figure 10).

Figure 10. *Onthophagus nuchicornis* burrows in sand under
cattle dung at Pembrey Burrows.

Pennard and Penmaen Burrows

The dung beetle fauna was relatively poor, with both low species richness (9) and relative abundance (39 individuals). The area is dominated by the golf course, but the western end of the site contains some remnants of the dune system. Cattle graze across the site, including the golf links. At the western end, a small number of *O. nuchicornis* were recorded. Searching across the golf links, where there was adequate dung yielded few species and low abundance. It is likely that *O. nuchicornis* will be restricted to the western edge of remnant dune system. The adjacent Penmaen

Burrows can be reached by the cattle from Pennard Burrows during low tide (Figure 11), and this access has undoubtedly provided the food source for the dung beetles found here (7 species). No *O. nuchicornis* were recorded on this side of the bay. A small area of dune remains and provided the cattle migrate to this area, it is possible that a low-level population of *O. nuchicornis* could be supported as a spill-over from Pennard Burrows.

Figure 11. Cattle grazing in the bay between Pennard and Penmaen Burrows.

Whiteford Burrows NNR

The dung beetle fauna at Whiteford Burrows NNR is quite impressive with a high species richness (19). The relative abundance was high for the most widespread and common species but was low for the scarcer species. Although *O. nuchicornis* has a long history at this site, we failed to find it in abundance. The only specimens found were of five individuals on human faeces on the mobile dunes, despite sieving horse dung across the site for several hours. The low capture rate / population is probably explained by the horse grazing being limited to areas of fixed dune (Figure 12) and the dune-saltmarsh habitat which are less favourable to *O. nuchicornis*. In our experience *O. nuchicornis* avoids areas with long sward height and high moisture content soils.

Figure 12. Horse grazing is restricted to fixed dune ‘damp’ grassland at Whiteford Burrows.

5.2.2. Sites at which *Onthophagus nuchicornis* may have gone locally extinct

Aberdovey [Aberdyfi] sand dunes

This locality is listed on the strength of a single record from 1963 by Gilmour. The voucher specimen is housed at the Doncaster Museum and has not yet been verified by the authors. Approximately half of the fore dunes in this area were converted to a golf course in the late 1800's and the Golf Club also owns part of the dune system that retains Common Grazing Rights (Doody, 2012). However, low economic returns and practicalities for grazing numerous small and dispersed sites have resulted in such arrangements becoming unattractive to many graziers. As a consequence, grazing at the site has declined.

Barmouth area including Tal-y-bont dunes

The area has been extensively developed for the tourist trade and there are several large camping and caravan parks on the shore front between Barmouth and Tal-y-bont. No livestock were encountered other than that on improved pasture alongside the A496 road. Morfa Dyffryn NNR lies north of Tal-y-bont and it is conceivable that old *O. nuchicornis* records labelled 'Barmouth area' could relate to this location. Very old cattle dung was found on site which yielded low numbers of two species, *Melinopterus sphacelatus* and *Aphodius foetidus*, both of which can also feed on dog faeces and in rabbit middens. Recent cattle grazing was not evident at the time of the survey and this lack of regular grazing certainly led to decline and likely local extinction of *O. nuchicornis*.

Crymlyn Burrows SSSI

One of the first known UK sites as reported by Dillwyn (1828 [1829]) and Stephens (1830). This dune system has long since been un-grazed and the occurrence of *O. nuchicornis* until the late 1990's was likely due to the regular use of this site for horse trekking, which has since diminished. The site is still used by dog walkers, but the quantity and quality of dung is unlikely to allow dung beetle populations to thrive. Based on this and other recent surveys conducted by the authors (1995, 1996, 1997, 1999, 2015), it is thought that *O. nuchicornis* has disappeared from the site.

Llangennith Burrows

There was no evidence of grazing on the fore dunes. Old sheep dung was found in a paddock in a grassland area behind the dune slacks, south-west of Broughton Farm caravan park in which two other *Onthophagus* species were recorded. Whilst a recently bulldozed area had exposed the sand, no fresh dung was found. Due to the proximity of this site to other *O. nuchicornis* sites, the introduction of cattle grazing may provide potential for a breeding colony.

Rhossili Down

The dung beetle fauna at Rhossili was reasonable, with 10 species but generally low abundance. The site is sheep grazed and bridleway had recent horse dung. The survey only covered part of the northern end of the site. A single specimen of *O. nuchicornis* was recorded in 2006. Rhossili Downs appears to be permanently grazed by sheep, but most of the area is unfavourable to *O. nuchicornis* (e.g. limited sandy soils, bare areas). There are potentially suitable areas in the southern end near Rhossili itself, and in the Northern end close to Hillend, so further field work would be advisable. The

proximity of Rhossili to Llangennith Burrows, a historic site for *O*. *nuchicornis*, suggests that this species may still persist in the area at low population levels.

Tenby dunes

The site has mostly been converted to a golf course, with minimal natural dune system in place. There is no grazing or access for horse riders and therefore, no longer a suitable dung supply for *O*. *nuchicornis*.

5.3. Non-target Species

Non-target species recorded during the 2017 survey are presented in data matrix by site in alphabetical order (Appendix 2). Full data is available in the accompanying supplementary material. Descriptions for non-target species are given in alphabetical order in Appendix 1.

6. Management Recommendations

6.1. *Rhysothorax rufa*

As little is known of the ecology of this species, management recommendations are based on assumed information gleaned from the literature and related ecological information. As *R. rufa* is likely to be associated with mobile dunes or areas where there has been recent disturbance, management practices that favour dune mobility are suggested so that a dynamic dune system with mobile fore dunes, regenerating slacks and blow outs are maintained.

The current management practices of dune rejuvenation at both Merthyr Mawr Warren NNR (Figure 13) and Kenfig Burrows NNR (Figure 14) appear to be creating suitable disturbed habitats for *R. rufa*. Survey efforts should continue in order to locate this difficult to find species

Figure 13. Blow outs and sand disturbance at Merthyr Mawr NNR. Suitable habitat for *Rhysothorax rufa.*

Figure 14. Blow outs and sand disturbance at Kenfig Burrows NNR. Suitable habitat for *Rhysothorax rufa.*

6.2. *Onthophagus nuchicornis*

The localised extirpation of *O. nuchicornis* at several of the known sites can be explained by the loss of dung continuity and in many cases the complete cessation of grazing. In addition, the limitation at some sites for livestock to roam across areas of mobile dunes and disturbed bare ground reduces the favourable conditions (i.e. dung on bare sand) that *O. nuchicornis* appears to thrive on.

The greatest threat to *O. nuchicornis* is the disruption or cessation of dung availability, in particular during the breeding season (April – September). Many of the sites are isolated and as such the cessation of grazing for just one season, or even part of the breeding season, would have devastating effects on the dung beetle's population and lead to lead to site level extinction. Unlike many of the other dung beetles, O. *nuchicornis* requires dry sandy soils on which to breed and there are very limited alternative sites within dispersal range of the current populations.

Although *O. nuchicornis* is often found in dog faeces (e.g. Cooter, 1990; Mann & Watkins, unpub. obs.), it is unlikely that this single source of food could maintain healthy populations, especially in light of the recent trend of bagging up dog dung and the anti-fouling legislation and enforcement. A study (Carpaneto *et al*., 2005) of an urban area in Italy, noted that the loss of herbivore dung (over a ten-year period) and the replacement with dog faeces as the only source of food for dung beetles had an associated decline in species richness and relative abundance of the majority of species.

The treatment of livestock with endectocides will be detrimental, reducing adult fecundity and survival and increasing mortality rates in larvae.

6.3. General Recommendations

- Continuity of grazing at sites that currently support grazing, especially between April and September;
- Sites with horse grazing only are encouraged to introduce cattle grazing at a small scale to increase dung availability;
- Ensure livestock have access to mobile dunes and/or areas of open sand to encourage deposition of dung on sand;

- Where possible, introduce livestock at sites currently un-grazed;
- Treatment of on-site livestock with veterinary products should be minimised and avermectins avoided. Worm burden should be monitored through faecal egg counts and endectocide treatment should only be carried out when absolutely necessary. Treatment of livestock should be conducted off-site and the animals not returned for at least 14 days;
- Maintain and encourage access for equine users at sites where this exists;
- Raise public awareness of dung beetles at key sites by adding information to the Natural Resources Wales website and to site notice boards.

6.4. Site Specific Recommendations

Kenfig Burrows

- As a minimum, maintain of current levels of grazing;
- Ensure livestock have continued access to mobile dunes and/or areas of open sand to encourage deposition of dung on sand;
- Maintain continuity of access for horse riding;
- Encourage the inclusion of notification about the use of endectocides as part of horse riding permit application, requesting that horses that have recently undergone treatment (with 7 days) should not be exercised on site;
- Provide signage to highlight the importance of dung beetles at this location.

Merthyr Mawr Warren NNR

- As a minimum, maintain of current levels of grazing;
- Extension of cattle grazing to compartments with open areas of sand and/or the mobile dunes;
- Maintain continuity of access for horse riding;
- Encourage the inclusion of notification about the use of endectocides as part of horse riding permit application, requesting that horses that have recently undergone treatment (with 7 days) should not be exercised on site;
- Provide signage to highlight the importance of dung beetles at this location.

Llangennith Burrows

- Introduction of cattle grazing (small herd of a traditional or heritage breed preferred);
- Ensure livestock have access to mobile dunes and/or areas of open sand to encourage deposition of dung on sand.

Morfa Harlech NNR

- Introduction of cattle grazing (small herd of a traditional or heritage breed preferred);
- Ensure livestock have access to mobile dunes and/or areas of open sand to encourage deposition of dung on sand.

Oxwich Burrows NNR

- As a minimum, maintain of current levels of grazing;

- Ensure livestock have access to mobile dunes and/or areas of open sand to encourage deposition of dung on sand;
- Introduction of cattle grazing (small herd of a traditional or heritage breed preferred). This should be particularly beneficial at Oxwich due to the current situation with very dry horse dung. However, it must be noted that it may take a couple of years for species abundance to recover.

Pembrey Burrows LNR

- As a minimum, maintain of current levels of grazing;
- Increase area of grazed by livestock, preferably to encompass areas of mobile dunes;
- Ensure livestock have access to mobile dunes and/or areas of open sand to encourage deposition of dung on sand.

Pennard Burrows (inc. Penmaen Burrows)

- As a minimum, maintain of current levels of grazing;
- Ensure livestock have access to mobile dunes and/or areas of open sand to encourage deposition of dung on sand;
- Ensure that the golf course does not routinely use chafer grub control (chemical treatments such as Merit® Turf (imidacloprid)), especially at the western end of the golf links.

Rhossili Downs NT

- Ensure livestock have access to areas of sandy soil. In particular between the Old Rectory (SS41638914) and East of The Green (SS41528825) to encourage deposition of dung on sandy soil.

Whiteford Burrows NNR

- As a minimum, maintain of current levels of grazing;
- Ensure livestock can access to mobile dunes and/or areas of open sand to encourage deposition of dung on sand;
- Introduction of cattle grazing (small herd of a traditional or heritage breed preferred);
- Provide signage to highlight the importance of dung beetles at this location.

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9. Appendix 1. Descriptions for non-target species recorded during the survey period (alphabetical order).

Acrossus depressus (Kugelann, 1792)

Aphodius depressus (Kugelann, 1792)

Status: Native, widespread
Activity Period: April-June
Comments: A widespread species across the UK. It occurs in grassland habitats and utilises the dung of cattle, sheep, and horse.
Size = 6-9mm.

Acrossus luridus (Fabricius, 1775)

Aphodius luridus (Fabricius, 1775)

Status: Native, widespread
Activity Period: June-September
Comments: A widespread species across the UK. It occurs in well drained grassland habitats and utilises the dung of cattle and sheep.
Size = 6-9mm.

Acrossus rufipes (Linnaeus, 1758)

Aphodius rufipes (Linnaeus, 1758)

Status: Native, widespread
Activity Period: June-September
Comments: This is one of the most widespread and abundant species across the UK. It occurs in all types of grassland habitats and utilises the dung of cattle, sheep, and horse. This species is also attracted to light.
Size = 9-13mm.

Aegialia arenaria (Fabricius, 1787)

Status: Native, widespread
Activity Period: April-October
Comments: This species is restricted to coastal dune systems, where it can often be abundant. A saprophagous species that can be found wandering on loose sand or in sand at the base of plants.
Size = 2-4mm.

Agoliinus lapponum Gyllenhal, 1808
Aphodius lapponum (Gyllenhal, 1808)

Status: Native, Scotland, Wales (north of the Brecon Beacons) and England (north of Severn to the Wash)
Activity Period: May-September
Comments: A widespread species in upland habitats. It will feed on all dung types but has a preference for sheep dung.
Size = 4-6mm.

Agrilinus ater (De Geer, 1774)
Aphodius ater (De Geer, 1774)

Status: Native, widespread
Activity Period: April-July
Comments: A widespread and abundant species in the UK, occurring in all habitats, though most abundant on open grasslands. It will feed on all dung types but has a preference for sheep dung.
Size = 4-6mm.

Anomala dubia (Scopoli, 1763)
Anomala aenea (DeGeer, 1774)
Anomala frischii (Fabricius, 1775)

Dune Chafer
Status: Native, local
Activity Period: May-July
Comments: The dune chafer is restricted to sandy soils, and almost exclusively to coastal sand dune systems. It is expected to be widespread across the dunes in Wales.
Size = 12-15mm.

Anoplotrupes stercorosus (Scriba, 1791)
Geotrupes sylvaticus (Panzer, 1798)

Status: Native, widespread but most often found in the West and North
Activity Period: March-October
Comments: This Dor beetle is particularly found in woodlands but may also be present in open habitats such as upland grasslands.
Size = 12-19mm.

Aphodius fimetarius (Linnaeus, 1758)

Status: Native, widespread
Activity Period: March-October
Comments: A widespread and abundant species in the southern half of the UK, becoming local in the North. A species of most habitats, but more abundant on open grasslands. It will feed on all dung types but has a preference for old cattle dung.
Size = 5-8mm.

Aphodius foetidus (Herbst, 1783)
Aphodius foetidus (Herbst, 1783)
Aphodius scybalarius auct. nec (Fabricius, 1781)

Status: Native, widespread
Activity Period: April-July; October
Comments: This beetle is widespread. It is associated with open grasslands and shows a preference for sandy soils, feeding on most types of dung.
Size = 5-8mm.

Aphodius pedellus (De Geer, 1774)
Aphodius fimetarius sensu auctt. partim non (Linnaeus, 1758)

Status: Native, widespread
Activity Period: March-October
Comments: A widespread and abundant species in the UK, occurring in all habitats. It will feed on all dung types but has a preference for old cattle dung.
Size = 5-8mm.

Bodilopsis rufa (Moll, 1782)
Aphodius rufus (Moll, 1782)
Aphodius rufesens (Fabricius, 1801)

Status: Native, Widespread
Activity Period: June-September
Comments: A widespread and abundant in the UK. It is one of most variable species, ranging in colour from almost black to straw yellow. Such variation makes it one of the more difficult species to identify. It is summer active, occurring in a range of habitats in all types of dung.
Size = 5-7mm.

Calamosternus granarius (Linnaeus, 1767)
Aphodius granarius (Linnaeus, 1767)

Status: Native, widespread, becoming scarce in the North
Activity Period: April-June
Comments: This is a widespread species throughout England and Wales, where it occurs in all grassland habitats. Along with dung of all types, this species can be found in other organic material such as manure heaps and compost.
Size = 3-5mm.

Colobopterus erraticus (Linnaeus, 1758)

Status: Native, widespread but less so in the northern UK
Activity Period: April-September
Comments: A widespread species in southern England and Wales, becoming localised in the North, not recorded from Scotland. A preference for permanent pasture and open grasslands, feeding on all dung types.
Size = 6-9mm.

Dorcus parallelipedius (Linnaeus, 1758)

Status: Native, widespread in the south but becoming less frequent further north. Absent from Scotland.
Activity Period: Found throughout the year but adults most often recorded between May-September
Comments: Lesser stag beetle larvae feed on white rotted hardwood. Adults are generally nocturnal and will come to light but also found walking around in daylight hours during the peak activity time in the summer months.
Size = 18-32mm.

Esymus medarius (Fabricius, 1775)
Aphodius merdarius (Fabricius, 1775)

Status: Native, **Nationally Scarce**
Activity period: May-August
Comments: This species has undergone a decline in the Uk, likley due to the increase of 'poo picking' from horse grazed pasture. An open grassland species with a preference for fresh horse dung.
Size = 4-5mm.

Esymus pusillus (Herbst, 1789)
Aphodius pusillus (Herbst, 1789)

Status: Native, widespread
Activity period: April-July
Comments: A species of open grassland occuring in all types of dung, with a preference for sheep dung.
Size = 3-5mm.

Euheptaulacus villosus (Gyllenhal in Schönherr, 1806)

Status: Native, **Nationally Scarce**
Activity period: May-August
Comments: This species prefers well drained soils particularly sandy or chalky soils. This species is most often recorded through sweeping or hand searching, since it is not an obligate dung feeeder. Adults are occasionally recorded in dung and from vegetable matter.
Size = 3-5mm.

Geotrupes stercorarius (Linnaeus,1758)

Status: Native, widespread
Activity Period: April-October
Comments: This Dor beetle is found in all habitats. It uses dung of all types but has a preference for horse dung.
Size = 16-25mm.

Hoplia philanthus (Füssly, 1775)

Hoplia farinosa sensu actt. non (Linnaeus, 1761)

Status: Native, widespread in England and Wales, rare in Scotland
Activity period: May-August
Comments: The only British species of this genus. It is usually seen in meadows and along hedgerows and woodland edges on flowers.
Size = 8-10mm.

Liothorax plagiatus (Linnaeus, 1767)

Aphodius plagiatus (Linnaeus, 1767)

Status: Native, **Nationally Scarce**
Activity period: May-August
Comments: A detritivore that is often found among pool side and strand line debris or under stones in damp areas in coastal regions.
Size = 4-5mm.

Melinopterus prodromus (Brahm, 1790)

Aphodius prodromus (Brahm, 1790)

Status: Native, widespread
Activity Period: September-May
Comments: A widespread and often abundant species in the UK occurring in all habitats, feeding on all dung types including dog faeces and deer and rabbit droppings.
Size = 4-7mm.

Melinopterus sphacelatus (Panzer, 1798)
Aphodius sphacelatus (Panzer, 1798)

Status: Native, widespread
Activity Period: September-May
Comments: A widespread and often abundant species in the UK occurring in all habitats, feeding on all dung types including dog faeces and deer and rabbit droppings.
Size = 4-6mm.

Melolontha melontha (Linnaeus, 1758)

Status: Native, widespread
Activity Period: April-May
Comments: The most common and widespread chaffer in the UK occurring in all habitats. Larvae are root feeders. Can occur in large numbers. Readily comes to light.
Size = 23-30mm.

Otophorus haemorrhoidalis (Linnaeus, 1758)
Aphodius haemorrhoidalis (Linnaeus, 1758)

Status: Native, widespread
Activity Period: May-August
Comments: This species occurs in all types of dung on open grasslands, with a preference for medium aged cattle dung.
Size = 4-5mm

Onthophagus coenobita (Herbst, 1783)

Status: Native, widespread in southern England and Wales. Absent from Scotland
Activity Period: April-September
Comments: This species occurs in all types of dung including dog faeces in a variety of habitats including those with heavy soils.
Size = 6-9mm.

Onthophagus joannae (Goljon, 1953)
Onthohpagus ovatus sensu auctt. partim non (Linnaeus, 1767)

Status: Native, widespread in southern England and Wales. Absent from Scotland
Activity Period: April-August
Comments: This species occurs in all types of dung including rabbit droppings but has a preference for sheep dung. Found on well drained sites often with chalky or sandy soils.
Size = 4-6mm.

Onthophagus similis (Scriba, 1790)
Onthophagus fracticornis sensu auctt. Brit. non (Preyssler, 1790)

Status: Native, widespread in southern England and Wales. Absent from Scotland
Activity Period: April-September
Comments: This species occurs in all types of dung including dog faeces in a wide variety of habitats but prefers well drained soils.
Size = 4-7mm.

Planolinus borealis (Gyllenhal, 1827)
Aphodius borealis (Gyllenhal, 1827)

Status: Native, local
Activity Period: May-September
Comments: This species occurs in all types of dung including deer droppings in shaded habitats and occasionally dunes in the north and west.
Size = 3-6mm.

Phyllopertha horticola (Linnaeus, 1758)

Status: Native, widespread
Activity Period: May-July
Comments: This chaffer lives on grassland, often on poor or calcareous soil, where the larvae feed on a variety of roots and sometimes in large numbers. Adults often swarm in bright sunshine and feed on flowers.
Size = 7-12mm.

Psammodius asper (Fabricius, 1775)

Status: Native, **Critically Endangered**
Activity Period: April-June and August-October
Comments: Predominantly coastal with very few inland records, usually found on exposed sites with sandy soils. Adults are nocturnal occurring in and on sand at the roots of plants, under debris and have occasionally been found under seaweed on the strandline.
Size = 3-4mm.

Psammoporus insularis Pittino, 2006

Aegialia sabuleti sensu auctt. Brit. non (Panzer, 1797)

Status: Endemic, **Nationally Scarce**
Activity Period: April-September
Comments: A species usually associated with exposed riverine sediment habitats with few records from dune systems.
Size = 4-5mm.

Rhodaphodius foetens (Fabricius, 1787)

Aphodius foetens (Fabricius, 1787)

Aphodius aestivalis Stephens, 1839

Status: Native, widespread
Activity Period: June-September
Comments: This summer active species occurs widely in the UK, preferring open grasslands. It can be found in all types of dung, though it prefers older cattle and horse dung.
Size 5-7mm.

Tesarius mcclayi (Cartwright, 1955)

Status: Introduced, local (Glamorgan only)
Activity Period: April-June and August-October
Comments: A North American species first discovered at Crymlyn Burrows SSSI (Glamorgan) dune system in 1995 (Mann, 1998) and Merthyr Mawr Warren NNR (Glamorgan) in 2015 (Harrison, 2015). This survey recorded this species at the known sites of Crymlyn Burrows SSSI, Merthyr Mawr Warren NNR and at Kenfig Burrows NNR for the first time. Size = 3-4mm.

Teuchestes fossor (Linnaeus, 1758)
Aphodius fossor (Linnaeus, 1758)

Status: Native, widespread
Activity Period: May-August
Comments: A widespread and often abundant species associated with all grassland habitats and feeds on most dung types but has a preference for cattle dung.
Size = 8-11mm.

Violinus sticticus (Panzer, 1798)
Aphodius sticticus (Panzer, 1798)
Aphodius equestris (Panzer, 1798)

Status: Native, widespread in south, localised in the North
Activity Period: April-August
Comments: This species has a strong preference for dung in shaded habitats (e.g. woodland, scrub, woodland edge), though during its later activity period it is known to occur in open habitats. Size = 4-5mm.

10. Appendix 2. All non-target species recorded during the 2017 survey by site. Group: D – dung feeder; C – chafer; O – other

Group	D	D	D	O	D	D	C	D	D	D	D	D	D	D	D	O	D	D	O	D	C	O	D	D	C	D	D	D	D	C	O	O	D	D	O	D
Site	***Acrossus depressus***	***Acrossus luridus***	***Acrossus rufipes***	***Aegialia arenaria***	***Agoliinus lapponum***	***Agrilinus ater***	***Anomala dubia***	***Anoplotrupes stercorosus***	***Aphodius fimetarius***	***Aphodius foetidus***	***Aphodius pedellus***	***Bodilopsis rufa***	***Calamosternus granarius***	***Colobterus erraticus***	***Dorcus parallelipipedus***	***Esymus merdarius***	***Esymus pusillus***	***Euheptaulacus villosus***	***Geotrupes stercorarius***	***Homoplia philanthus***	***Liothorax plagiatus***	***Melinopterus prodromus***	***Melinopterus sphacelatus***	***Melolontha melolontha***	***Otophorus haemorrhoidalis***	***Onthophagus coenobita***	***Onthophagus joannae***	***Onthophagus similis***	***Planolinus borealis***	***Phyllopertha horticola***	***Psammodius asper***	***Psammoporus insularis***	***Rhodaphodius foetens***	***Teuchestes fossor***	***Tesarius mcclayi***	***Violinus stictficus***
Aberdyfi dunes				✓		✓	✓																✓				✓	✓		✓						
Borth Sands																														✓						
Bridgend, Parc-y-parcau		✓				✓					✓			✓								✓	✓			✓		✓								✓
Bryn Mawr	✓					✓					✓																						✓			
Bwlch Mawr						✓																✓	✓													
Caerau						✓					✓												✓													
Candleston Farm						✓																✓						✓								✓
Cefn Bryn						✓			✓					✓					✓			✓	✓										✓			
Crymlyn Burrows SSSI				✓																		✓						✓				□		✓		
Fairwood Common	✓					✓			✓										✓			✓	✓					✓					✓			
Ffridd Cefn-isaf	✓					✓																✓	✓					✓								
Kenfig Burrows NNR		✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓				✓		✓		✓	✓	✓	✓			✓	✓			□	✓	✓	✓	✓
Llangennith Burrows						✓																					✓	✓								
Llwyngwnadl Uchaf						✓																✓	✓													
Llwynysgaw									✓	✓	✓		✓																				✓	✓		
Madryn Farm																								✓						✓						
Group	D	D	D	O	D	D	C	D	D	D	D	D	D	D	D	O	D	D	O	D	C	O	D	D	C	D	D	D	D	C	O	O	D	D	O	D

Site	*Acrossus depressus*	*Acrossus luridus*	*Acrossus rufipes*	*Aegialia arenaria*	*Agoliinus lapponum*	*Agrilinus ater*	*Anomala dubia*	*Anoplotrupes stercorosus*	*Aphodius fimetarius*	*Aphodius foetidus*	*Aphodius pedellus*	*Bodilopsis rufa*	*Calamosternus granarius*	*Colobterus erraticus*	*Dorcus parallelipipedus*	*Esymus merdarius*	*Esymus pusillus*	*Euheptaulacus villosus*	*Geotrupes stercorarius*	*Homoplia philanthus*	*Liothorax plagiatus*	*Melinopterus prodromus*	*Melinopterus sphacelatus*	*Melolontha melolontha*	*Otophorus haemorrhoidalis*	*Onthophagus coenobita*	*Onthophagus joannae*	*Onthophagus similis*	*Planolinus borealis*	*Phyllopertha horticola*	*Psammodius asper*	*Psammoporus insularis*	*Rhodaphodius foetens*	*Teuchestes fossor*	*Tesarius mcclayi*	*Violinus sticticus*
Merthyr Mawr Warren NNR		✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓				✓	✓	✓			✓	✓	✓			✓	✓		✓	✓	✓
Moel Caerau		✓					✓							✓								✓	✓													
Moel Fferm	✓					✓																✓	✓												
Morfa Dinlle				✓					✓	✓	✓												✓		✓					✓				✓		
Morfa Dinlle SSSI						✓																✓	✓												
Morfa Dyffryn				✓						✓																	✓								
Morfa Dyffryn NNR				✓					✓	✓	✓											✓	✓				✓		✓						
Morfa Harlech NNR				✓			✓			✓						✓						✓	✓				✓		✓						✓
Mynydd Gwerngraig	✓				✓	✓		✓																											
Nant y Cwreiddyn	✓		✓			✓		✓														✓	✓												✓
Nant-y-moch Resevoir	✓					✓													✓			✓	✓												
Neuadd-ddu	✓					✓																	✓												✓
Newborough Warren NNR	✓		✓			✓			✓	✓	✓					✓	✓					✓	✓		✓			✓		✓			✓		✓
Nicholaston Burrows NT				✓																															
Oxwich Burrows NNR	✓		✓			✓					✓			✓			✓		✓			✓	✓		✓			✓					✓	✓		✓
Pant-y-Rhedyn	✓				✓	✓																✓	✓												
Pembrey Burrows						✓				✓			✓			✓											✓	✓								✓
Pembrey Burrows LNR				✓		✓			✓	✓	✓		✓								✓				✓			✓		✓	✓			✓		
Pembrey Country Park																														✓						
Group	D	D	D	O	D	D	C	D	D	D	D	D	D	D	O	D	D	O	D	C	O	D	D	C	D	D	D	D	D	C	O	O	D	D	O	D

Site	*Acrossus depressus*	*Acrossus luridus*	*Acrossus rufipes*	*Aegialia arenaria*	*Agoliinus lapponum*	*Agrilinus ater*	*Anomala dubia*	*Anoplotrupes stercorosus*	*Aphodius fimetarius*	*Aphodius foetidus*	*Aphodius pedellus*	*Bodilopsis rufa*	*Calamosternus granarius*	*Colobterus erraticus*	*Dorcus parallelipipedus*	*Esymus merdarius*	*Esymus pusillus*	*Euheptaulacus villosus*	*Geotrupes stercorarius*	*Hoplia philanthus*	*Liothorax plagiatus*	*Melinopterus prodromus*	*Melinopterus sphacelatus*	*Melolontha melolontha*	*Otophorus haemorrhoidalis*	*Onthophagus coenobita*	*Onthophagus joannae*	*Onthophagus similis*	*Planolinus borealis*	*Phyllopertha horticola*	*Psammodius asper*	*Psammoporus insularis*	*Rhodaphodius foetens*	*Teuchestes fossor*	*Tesarius mcclayi*	*Violinus sticticus*
Pendine Burrows	✓			✓													✓						✓			✓									
Penmaen Burrows				✓																		✓													
Penmaen Heath NT													✓						✓			✓	✓					✓					✓		✓
Pennard Burrows				✓		✓				✓												✓			✓								✓		
Pennard Burrows Golf Links									✓	✓									✓														✓		
Pen-y-graig																									✓								✓		✓
Portobello House										✓							✓					✓	✓		✓		✓	✓							✓
Reynoldston																						✓	✓					✓					✓		
Rhossili Down NT			✓			✓				✓			✓						✓			✓	✓		✓		✓	✓							
Ryer's Down NT			✓			✓											✓		✓			✓	✓					✓							✓
Tenby, The Burrows																		✓					✓												
Tywyn Aberffraw						✓					✓					✓						✓	✓					✓		✓					✓
Tywyn Trewan Common				✓																			✓												✓
Whiteford Burrows NNR	✓	✓	✓	✓		✓			✓	✓	✓		✓				✓	✓			✓	✓	✓		✓	✓	✓	✓					✓		✓
Ynyslas Dunes NNR				✓		✓				✓												✓	✓				✓	✓		✓					

11. Appendix 3. Data Archive Appendix

The data archive contains:

[A] The final report in Microsoft Word and Adobe PDF formats.

[B] Species records, which are held on the NRW Recorder 6 database.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue http://libcat.naturalresources.wales or http://catllyfr.cyfoethnaturiol.cymru by searching 'Dataset Titles'. The metadata is held as record no. 121588.

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